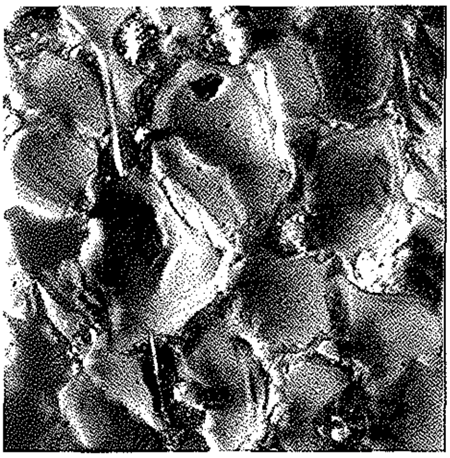

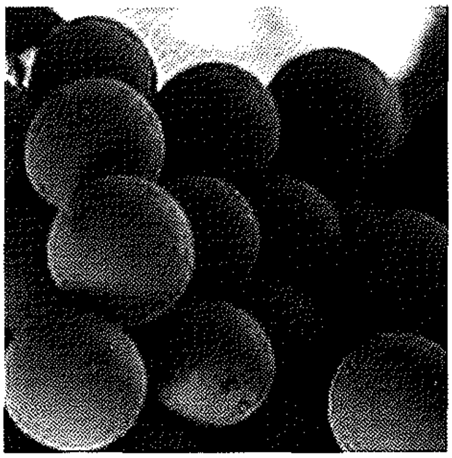

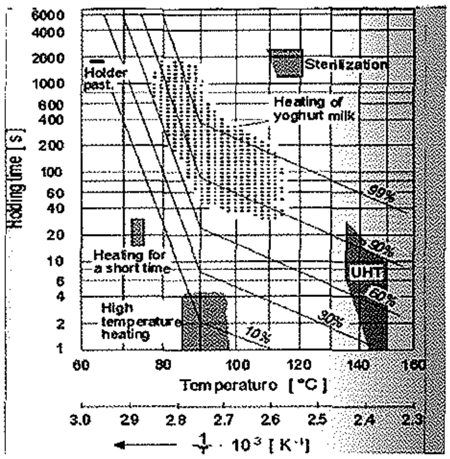

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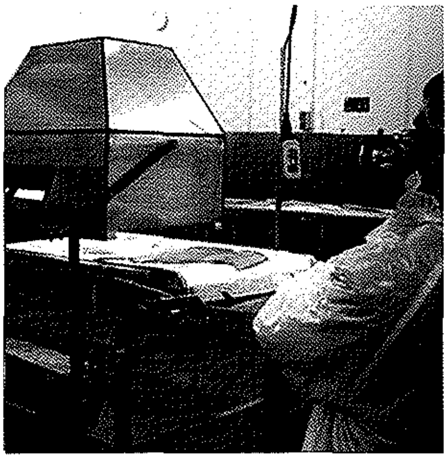

PROGRAM BOOK AND ABSTRACTS

ChIA
Instituto Chileno de Ingeniería para Alimentos A.G.

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Viña del Mar- Chile, April 20-24, 2008
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F01

STRATEGY FOR MINIMIZING THE UNCERTAINTY ON CONCENTRATION-DEPENDENT DIFFUSIVITY AS IDENTIFIED BY TWO INVERSE METHODS

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Models of mass transport in foods do require a large number of parameters, many of which are not available for food materials. Although data on effective diffusivity are abundant in literature, "true" diffusivities applying to the case of molecular diffusion are rather scarce. In fact, measurements of molecular diffusivity (*D*) are not easy in foods and require dedicated devices with multiple cautions. Surprisingly, little concern has been paid to uncertainty accompanying diffusivity coefficients, although crucial. Classically, the unknown *D* function is identified by minimizing iteratively a merit function that assesses the closeness of the experimental concentration profiles to the simulated ones (method A). A different method compares the mass fluxes to the concentration gradients which both can be estimated locally from concentration profiles (method B). Advantageously, knowledge about the concentration at the interface and the function linking *D* to concentration is not a requirement in the method B. The objective of the present study was to identify the requirements for the set of data so to reach a given level of uncertainty on *D* for both methods (A and B). The number of profiles (time resolution), the number of points per profile (space resolution) and the uncertainty on concentration were basic characteristics of the set of data. Virtual desorption/sorption kinetics were designed in order to compare the estimated value of *D* with a known reference. The probability density function of *D* was accessed numerically through the production of *m* virtual sets of data and applying *m* times the optimisation procedure. Thus, when the uncertainty on concentration was weak (< 5 %), both methods led to the same accuracy of *D*. For uncertainties on concentration higher than 5 %, the method B decreased accuracy of *D*. To increase the accurateness, it was necessary to increase the time and temporal resolution (e.g. error on *D* was close to the noise intensity if the numbers of concentration profiles or concentration data per profile were higher than 20). If these results were to the advantage of the method A, the weakness of it, was the assessment of the concentration at the interface.

F02

A THERMAL CONDUCTIVITY PREDICTION METHOD FOR FROZEN FOODS

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Thermal conductivity is a key parameter for predicting freezing times and designing food freezing processes. Often a food's thermal conductivity will need to be modelled, either because no measured data are available, or because it may vary significantly during processing. The uncertainty involved in predicting the thermal conductivity of a food product depends on its composition: unfrozen, non-porous foods are the simplest foods to model, while frozen non-porous foods are more difficult and frozen non-porous foods are the most complicated. Most food engineering handbooks provide a list of effective thermal conductivity models which may be used, but provide little guidance about which models should be used with which food and under which conditions. This paper presents a systematic procedure recommended for predicting the thermal conductivity of frozen foods.

The method is based on a stepwise procedure where a food's components are combined successively, according to the magnitude of their conductivities. First the components other than ice and air are combined to form a 'preliminary phase' whose thermal conductivity is determined using the Parallel model. The ice is combined with the preliminary phase using Levy's thermal conductivity model to produce the 'frozen phase'. If there is significant porosity the air is combined with the frozen phase mixture using the Maxwell-Eucken model in which the air forms the continuous phase. One of the major benefits of the proposed method is that the thermal conductivity models do not contain empirical parameters, meaning that, provided the composition is known, the method will provide true predictions (several model validation studies essentially fit a model to experimental data by suitable adjustment of an empirical parameter).

The prediction method was applied to a range of real food systems and the prediction accuracies were typically within ±20%. The accuracy of the procedure is strongly dependent on the choice of models for dealing with the ice and air components, and if the microstructure of the food is known, the error in the prediction method may be reduced to ±10%, which is acceptable for most design calculations.

F03

THERMAL PROPERTIES FROM TWO VARIETIES OF CAÑIHUA (*Chenopodium canihua* Cook)

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The physical, mechanical and thermal properties of agricultural products play an important role in equipment design, development and optimisation of food processing operation. The importance of studying the engineering properties of local agricultural products is that data can be used to innovate in processing and product development giving added value to aboriginal products. Furthermore, research about functional properties is needed.

The main goal of this research, was to determine thermal properties (thermal conductivity, thermal diffusivity and specific heat) for three levels of moisture content (10 to 20 % MC_{wb}), of cañihua grain (*Chenopodium cañihua* Cook) Cupi and Ramis varieties, which are important in the Altiplano region of Perú.

Chenopodium canihua Cook, is an andean cereal, similar to quinua, originated over the south american Andes mountains, mainly in the south of Perú and Bolivia, where was domesticated by aboriginal population

Two cañihua grain was used, both varieties Cupi and Ramis, from National Institute of Agrarian Investigation INIA - Salcedo. The measurement of thermal properties (thermal diffusivity, thermal conductivity and specific heat) of washed grains was conditioned at three humidity levels (10, 15 and 20 % with three replicates), under three temperature levels (25, 30, 35 °C). Transient method using 2 inches diameter copper tubes and needle with hot wire and thermocouple for thermal diffusivity and thermal conductivity respectively were used.

The thermal diffusivity is between 0.773 and 1.0 x 10^{-8} $m^2 s^{-1}$, the thermal conductivity is between 0.0728 to 0.0897 W m^{-1}°C^{-1} and its specific heat is between 0.865 to 0.905 kJ kg^{-1} °C^{-1}.

F04

THERMOPHYSICAL AND THERMODYNAMIC PROPERTIES OF MANGABA AND GRAVIOLA PULPS: EFFECT OF TEMPERATURE

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Fruits are an important source of nutrients in human diet. The idea of beneficial activity of fruits have promoted an increase in consume of